E/CONF.39/D/136
26 Oct.1962
ORIGINAL : ENGLISH

UNITED NATIONS CONFERENCE
ON THE APPLICATION OF SCIENCE AND TECHNOLOGY
FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

Agenda Item: D.4.2

Australia

COMMERCIALLY FEASIBLE METHODS FOR THE DEHYDRATION OF MEAT

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COMMERCIALLY FEASIBLE METHODS FOR THE DEHYDRATION OF MEAT.

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1. From earliest times meat has been preserved by sun-dryers. Meats sun-dried are still an article of commerce in some regions, though of variable, usually low, quality, acceptable by reason of acquired taste. In most of the less developed countries diet is often seriously deficient in animal protein, because of insufficient livestock or the physical or economic difficulties of providing them with meat. The special advantages of dried meats in these and like circumstances are: they weigh less, occupy (particularly if compressed) less space, save expensive packing materials such as tin-plate, and store well without costly refrigeration.

2. Drying methods other than sun-drying are termed 'dehydration'. Giving better quality and greater supply, meat can now be dried commercially in various types of dehydrators by processes that are strictly controllable. This paper is mainly concerned with dehydration and its technology, with emphasis on methods commercially feasible in under-developed countries.

DEHYDRATED MEATS

3. These may be prepared in many forms such as powder, mince, slices, chunks, steaks, and chops. By careful handling and correct processing much of the form is retained. For example, with a dried mince, there should be only a very small quantity of fine material.

4. When the freshly prepared product is reconstituted and cooked it should have a full meat flavour and be free of off-flavour. Stale flavours may result from use of carcasses with microbial slime, from dirty equipment, and from deterioration of the product during storage; foreign flavours from tainted air or proximity to volatile odours. Other off-flavours may occur such as rancid (due to rancidity of the fat), burnt (from overheating during drying), and pressure-cooked (through pressure pre-cooking).

5. The use of carcasses of aged animals results, except in heated air drying of mince, in a product lacking in tenderness and juiciness. Pressure cooking of meat results in not only an undesirable flavour but a defect known as "woolliness" which may be likened to chewing a piece of cotton wool. Products from the emaciated carcasses are dry and lack the desired degree of fattiness.

6. The dried product should be capable of fairly rapid

reconstitution, and of taking up sufficient water to ensure it is not lacking in juiciness. The time taken for reconstitution is highly dependent on the form of the product and its method of production.

7. The nutritive value of the protein of the dried product should approximate that of the freshly cooked meat from which it is prepared. Sharp[1] has shown the nutritive value of air-dried mince, as measured by feeding studies on rats, to be very satisfactory, when the drying temperature was kept below 80°C. The biological value of the protein falls during storage of the product. Changes in the vitamin content must be considered also, particularly the vitamin B group. Losses of these during the preparation of air-dried mince were similar, in general, to those during ordinary household cooking.

8. To ensure a good quality product of satisfactory keeping quality strict hygiene, including scrupulous cleanliness of person, equipment and premises are necessary in all stages of processing and subsequent handling. High standards of slaughtering and meat inspection must be observed. To limit growth of micro-organisms delays between stages should be avoided. There should be as little as possible physical handling of meat, particularly after it has been sterilized by pre-cooking.

DRYING METHODS

9. Sun-Drying. Sun-dried meats reconstitute very slowly and their flavour and texture do not closely resemble those of freshly cooked meat. Sharp[1] has described the traditional methods still in use for preparation of charqui, biltong and pemmican.

Charqui, an important article of commerce in Central and South America, is made from strips of fatty beef which are brined prior to sun-drying on racks. Bilton differs from charqui by being a lean product; strips of legs or loins are lightly cured before drying in the shade in open sheds. Pemmican, originally prepared by the North American Indians, consists of sun-dried strips of lean meat pounded to a fine meal and mixed with rendered fat.

10. Drying processes other than sun-drying are termed dehydration. A wide variety of methods have, for purposes of this paper, been grouped into three classes. The form, quality and keeping properties of the dried product vary considerably with the different methods of processing:

(a) Heated Air. Only pre-cooked mince can be dried satisfactorily by heated air. Boneless pieces of meat are cooked lightly and the resultant liquors are concentrated and returned to the minced cooked meat before it is dried. Further details and references to relevant research papers may be found in a paper by Prater.[2] Types of air dryers which have been used for drying mince include cross-draught and through draught dryers, both batch and continuous, and the roto-louvre. More recently, a belt trough dryer has been developed, capable of drying many granular products in a shorter time than more conventional types. Its suitability for meat still requires testing.

(b) Drying Under Reduced Pressure: By vacuum methods raw and cooked

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[1] Sharp, J.G., Dehydrated Meat, Spec. Rep. Fd. Invest. Bd., Lond., No. 57 (1953).

[2] Prater, A.R., Meat Dehydration, C.S.I.R.O. Aust. Div. Food Pres. Circ. 6-P (1962).

and steaks may be dried, as well as mince, but they are more expensive and difficult to convert from a batch to a continuous process. Using vacuum drying, dried chunks and steaks of acceptable quality may be produced; but not when the meat comes from carcasses of aged animals Meat of this quality is satisfactory only as air-dried mince, which is tenderized by the mincing operation. In the New Zealand vacuum method, water is removed rapidly by dropping frozen chunks of meat into molten fat contained in a vacuum vessel. The fat is heated in an external heat exchanger and acts as the heat transfer medium. Initial quality is usually reasonable, but storage properties are poor. An additional disadvantage is that overnight soaking is required for reconstitution. At its present stage of development the freeze drying method could not be considered commercially feasible for less developed areas. However, as the quality of certain products is often exceptionally high, it is felt it should be mentioned. Water frozen in the raw material is subsequently removed by sublimation under high vacuum at low temperatures. Several techniques recently developed for speeding up the process aim at maintaining quality with economy of cost.

(c) Contact Drying: The melter dryer is basically a steam jacketed horizontal cylinder fitted with a paddle agitator. The product consists of very small particles having an unpalatable, bitter, burnt flavour and is of low biological value. By the application of a vacuum, and by keeping the temperature below 70°C, an improved product can be produced but even so it is not comparable with the air dried product. Roller drying depends on exposing a meat slurry for a short time to contact with the surfaces of steam heated rollers maintained at a high temperature. Improvement in quality may be obtained by application of a vacuum and lowering the drying temperature.

11. Provided that meat in the form of mince is acceptable to the people concerned, it is considered that air drying compares more than favourably with the other methods described.

PACKAGING AND STORAGE

12. Types of Deterioration are set out below:

(a) Microbial Growth: Dried meat will absorb moisture readily if exposed to the atmosphere for any length of time, thus making possible the growth of moulds and bacteria. To prevent this the dried meat must be packed in a moisture-proof rigid or flexible container.

(b) Changes in Fat Fraction: Two well known types of chemical change which may take place in the fat fraction of dried meat are hydrolysis, leading to liberation of free fatty acids, and oxidation, leading to the onset of rancidity. The former does not have a serious effect on flavour and the latter can be controlled by gas or vacuum packing or, if permitted, by the use of antioxidants.

(c) Changes in the Protein Fraction: Exclusion of oxygen by gas or vacuum packing retards the development of certain off-flavours in the protein fraction, but others, termed "browning changes", develop in gas-packed material. Browning changes, which can be retarded, are not usually of serious consequence unless a particularly long shelf life is required.

13. Packing Methods: Rigid containers such as those made of tin-plate give not only the best moisture and gas barriers but, by their rigidity, protect the contents against damage. Flexible types may be used providing they serve as a good barrier to gas and moisture. Nitrogen is recommended for commercial gas packing of dried meat. Compression of air dried mince results in the exclusion of most of the air so giving a shelf life to the product which almost equals that of gas-packed material.

13. Effect of Temperature on Shelf Life: The shelf life of dried meat depends on a number of factors such as quality of raw materials, type of process, type of pack, and temperature of storage. Increasing the temperature of storage reduces the shelf life. For example, dried mutton mince has a storage life of approximately 10 months at 77°F. and 1½ years at 32°F. Gas packing increases these figures to 2½ years and somewhat greater than 3 years.

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